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Observations on the flora of central Chile

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From the fall of 1900 until the spring of 1903 the author held the position of teacher of sciences in the *Instituto Inglés*, an English school in Santiago, Chile. Short holidays during the school year and the long vacation from Christmas to the first of March gave opportunities for collecting trips about the city and to the mountains to the east. In these trips the small lakes in the neighborhood of Santiago were visited and the mountains ascended to a height of twelve thousand feet. The following observations give the results of these trips.

Midway between the damp forests of the south and the deserts of the north, central Chile has a flora related to that of both, yet differing from each. From sea-level to the limit of shrubby growth on the mountains, thorny bushes are the characteristic plants. Most plants of the region show xerophytic modifications, for no rain falls from the first of September till the following June. By October the ground is fairly dry over the hills and higher land. By late November the green of winter and early spring is everywhere replaced by the brown of dry vegetation. The rapid rivers have cut deep valleys through the mountains and across the central plain, so that naturally mesophytic areas are found only in very narrow belts along the streams or in small mountain marshes. An extensive irrigating system has modified these natural conditions in the central plain to a considerable extent.

About Santiago the floral regions may be determined largely by elevation. Thus, there is the central plain with an elevation varying from one thousand to fifteen hundred feet; the hills from fifteen hundred feet to the limit of tree-growth at from five to eight thousand feet, the limit being higher in the interior than in the outer ranges of mountains; above this comes the high mountain flora extending to the region of perpetual snow.

In the first region the typical plant is the thorn-bush (*espino*), *Acacia Cavenia*, a shrub usually under ten feet in height, but some-

times becoming a small tree. It blossoms in early spring when the leaves are first appearing. During the middle of the day the leaflets close together, diminishing the transpiring surface. Frequently the *espino* covers large areas with the regularity of trees in an orchard; such areas are called *espinales*. At other times it is found in company with other thorny shrubs, but always maintaining its position as the dominant form. Throughout the region introduced herbs have the ascendency over the native: *Brassica Rapa*, *Raphanus sylvestris*, *Capsella Bursa-pastoris*, *Sisymbrium officinale*, species of *Erodium*, *Foeniculum vulgare*, *Medicago maculata*, *M. denticulata*, *Trifolium repens*, *Hordeum jubatum*, *H. murinum*, *Fumaria media*, *Centaurea melitensis*, *Cynara Cardunculus*, and others are very common along the roadsides, at the edges of cultivated fields, on all waste land, and even on the lower mountain-slopes. During the summer these introduced plants make up the greater part of the vegetation. In the early spring a larger number of native plants are found; such as various species of *Oxalis* (*O. lobata*, *O. articulata* and *O. micrantha*), *Dioscorea humifusa*, *Sagina apetala*, *Trichopetalum stellatum* and *Leucocoryne ixioides*. Besides the *Acacia*, a few other shrubs or small trees are found, as *Prosopis juliflora* (*P. Siliquastrum*), *Cestrum Parqui*, and *Talguenea costata*. Several species of *Cuscuta* and *Senecio* are also common.

This region is the only one brought under cultivation to any extent. A large number of the country roads have been formed into *alamedas* by planting Lombardy poplars along the small irrigating ditches that run at each side. Below these poplars *Rubus ulmifolius* frequently is planted and often grows to a height of over fifteen feet, spreading out on each side to form an impenetrable wall, replacing the mud walls that usually border the roads.

Several small areas of this central plain have a very distinct flora. There are a few small lakes, such as Aculeo and Batuco, which are swampy along the shores. Also along the irrigating ditches there are occasionally swampy places. Here are found such plants as *Eleocharis palustris*, *Cyperus vegetus*, *Typha angustifolia*, *Potamogeton pectinatus*, *P. Berteroanus*, *Zannichellia palustris*, *Myriophyllum verticillatum*, *Lemna minor*, *L. gibba*, *Azolla magellanica*, and *Cotula coronopifolia*.

The low hill and mountain region may easily be subdivided, although the divisions can not be sharply limited. There is considerable difference between northern and southern exposures at the same elevation, and the upper limit of many species is higher in the interior mountains than in the outer ranges.

The flora of the hills that rise abruptly from the central plain, as Cerro Blanco, San Cristobel, Renca and San Bernardo, is intermediate between that of the mountains and that of the plains. The *Acacia* is still one of the characteristic plants, but with it are many other shrubs, *Talguenea costata*, *Lithraea caustica*, *Colletia ferox*, *Muehlenbeckia chilensis*, *Colliguaya odorifera*, *Ephedra andina*, and the tall, columnar *Cereus Quisco*. The clumps of *Ephedra* seem to be as numerous on these low hills as on the higher slopes, where it extends close to the snow-line. On the hills it may be from four to six feet high, though it is so commonly cropped by cattle that it rarely attains such a height, while near the snow-line it is a matted shrub six or eight inches high. The herbaceous plants are typically Chilean, though a few naturalized species, such as *Fumaria media*, *Erodium cicutarium*, *Convolvulus arvensis*, *Marrubium vulgare*, *Centaurea melitensis* and *Cynara Cardunculus* are common. In the early spring *Trichopetalum stellatum*, with its delicately fringed white flowers, *Leucocoryne ixioides*, *Pasithea caerulea*, blue and yellow *Sisyrinchium*, species of *Oxalis*, and other, chiefly bulbous, plants are common. A little later several species of *Calceolaria*, especially *C. nudicaulis*, *C. purpurea*, and *C. adscendens*, species of *Loasa*, *Cajophora*, *Bowlesia*, *Tropaeolum*, *Moscharia* and *Triptilion* are the characteristic plants. By the last of November most of the spring flowers have matured fruits and are in a resting condition that lasts until the winter rains begin. Throughout the summer flowers are rare. The most attractive are composites, species of *Mutisia*, *Centaurea chilensis* and *Triptilion* sp. There are also a large number of less showy species, including species of *Baccharis*, *Senecio*, *Conyza*, and *Erigeron*.

The mountains proper have a greater number of shrubs. Near the streams are a few small trees, *Maytenus Boaria*, *Blepharocalyx*, *Myrtus*, *Cryptocarya Peumus*, *Quillaja saponaria*, and *Kageneckia oblonga*, all evergreen. On the drier slopes are thorny

shrubs, *Talguenea*, *Colletia*, *Proustia pungens*, and others; poisonous shrubs, *Lithraea caustica*, *Colliguaya odorifera*, *C. integerrima* and *Cestrum Parqui;* and a few species of thornless broad-leafed trees, as the species of *Escallonia*. On the driest slopes are cacti, *Cereus Quisco* and smaller species, *Puya coarctata* and *Eryngium paniculatum*. The last two stand singly or in small groups and attract attention from a distance. *Puya* has a short prostrate trunk covered with the bases of dead leaves, at the end of which rises a crown of narrow, spine-toothed leaves often three feet long; from the center of this crown springs the flowering stalk, six to nine feet high, bearing a pyramid of blue-green flowers. These flowers contain an abundance of nectar and are much visited by bees and humming birds. *Eryngium paniculatum* resembles *Puya* in habit but is smaller. There are a few vines in this region. *Eccremocarpus scaber* is abundant in the moister situations, climbing over the shrubs and small trees, covering them with clusters of scarlet blossoms. In drier situations *Mutisia subulata* and *M. linearifolia* climb over anything to be found, and with their large heads of bright red are among the few bright flowers of summer. Of other plants the more common are species of *Calceolaria*, *Tropaeolum*, *Patagonium*, *Verbena*, and composites. Except along the small streams the vegetation is scattered, so that the gray, brown, or reddish soil gives the prevailing colors to the mountain sides. Near the streams the vegetation is denser. A shrub frequently found along the streams is *Aristotelia Maqui;* the purplish berries are used by the country people to prepare a beverage or to color wine. Some of the *Myrtaceae* are also found along the streams, chiefly species of *Eugenia*, *Myrtus*, and *Blepharocalyx*, while the "peumo," *Cryptocarya Peumus*, the soap-tree, *Quillaja saponaria*, and *Kageneckia oblonga* become trees forty to fifty feet high. Where the ground is swampy *Drimys Winteri*, the only representative of the *Magnoliaceae* in Chile, is found.

At an altitude of about 5,000 ft. in the outer mountains and of 7,000 ft. in the interior, *Kageneckia angustifolia* is found, marking the upper limit of tree-growth. Above that comes the high mountain vegetation.

In this last region two zones are found. In the lower the

plants are mainly in large low clumps or mats, the "Polster" formation of Reiche; in the upper the plants grow singly or in widely separated small clumps. The mats in the lower zone may be of one or several species. They are usually so dense that the lower portions are nearly solid with stems and dead leaves, with the green of new growth mantling the surface. Near the tree-line *Valenzuelia trinervis* is one of the principal plants in such formations. It grows to one or two feet in height and often solidly covers areas twenty to thirty feet in diameter. Similar, though smaller, mats are formed by the thorny umbellifer, *Mulinum spinosum*, by the composite, *Chuquiraga oppositifolia*, by *Ephedra andina*, and by other shrubby plants. With these there are other plants, especially bulbous ones, that develop in the spring while the ground is saturated with the water from melting snow. *Anemone chilensis*, *Diposis Bulbocastanum*, and species of *Liliaceae* and *Amaryllidaceae* are among these. *Luzula chilensis*, *Eleocharis striatula*, and a few grasses are found in marshy spots. Somewhat higher, *Laretia acaulis* forms dense mats, species of *Calceolaria* are found associated with various composites, *Aldunatea*, *Chaetanthera*, *Aplopappus*, and *Nassauvia*, species of *Argylia*, and others, all low perennials, in other mats.

The highest formation is of plants so scattered and small that from a short distance the ground seems absolutely barren. Of the plants found at these high levels many are tiny things hidden between stones and only noticed on close examination. *Aldunatea chilensis* may be taken as typical of these. The plant consists of a rosette of tiny leaves covered with a grayish felt. From the middle of a cluster of forty or fifty leaves grows the head, like a tiny daisy, the whole plant so small that it could be hidden under a quarter-dollar. Similar in general characters are *Viola Philippii* and other acaulescent violets, except that instead of a central flower a ring of tiny blue-black violets peep out around the rosette of leaves, the whole plant being rarely an inch and a half in diameter; the stout rootstock is closely marked with the scars of former leaves and blossoms. Other plants of similar habit are *Aldunatea gnaphalioides*, *Plantago* spp., and *Astragalus Germaini*, while *Nastanthus agglomeratus*, *A. spathulatus*, and *Phacelia circinata* are somewhat larger but of the same general habit.

An interesting group of plants was found in a little basin above Laguna Negra where the ground was saturated with water from the glacier a short distance above. *Luzula chilensis*, *Ranunculus chilensis* and *Calandrinia affinis* were growing in a thick carpet of moss. The delicate blossoms of the *Calendrinia* seemed like flakes of snow scattered from the neighboring drifts. Near the lake below grew *Tropaeolum polyphyllum*, *Schizanthus pinnatus* and species of *Hexaptera*. In the lake itself stood *Juncus pictus* and farther out a sparse growth of *Myriophyllum elatinoides ternatum*.

As has been mentioned, the southern slopes of the mountains have a flora somewhat different from the northern, as the south slopes are cooler and moister. As a result the vegetation on southern exposures is denser and more varied than that on the northern. At lower elevations the plants best fitted for desert conditions, such as *Cereus* and *Puya*, are found only on the northern slopes, while *Escallonia*, *Calceolaria*, *Verbena*, *Lippia* and others are found, chiefly on the southern.

Nearly everywhere *Cereus* serves as host for *Loranthus aphyllus*, the clusters of red flowers always springing from the axils of the thorns. These blossoms are usually considered to be the blossoms of the cactus by the country people. *Loranthus tetrandus*, abundant on the poplars of the long alamedas of the plain, is a serious pest on fruit trees and is found on nearly all the shrubs of the lower mountains. Other species of *Loranthus* are occasionally found and are confined to certain plants; thus *Loranthus cuneifolius* was found only on *Porlieria hygrometrica*.

Except for the small number of water and swamp plants, *Typha*, *Myriophyllum*, *Hydrocotyle*, *Montia*, *Potamogeton*, *Senecio fistulosus*, *Cotula*, *Eleocharis*, *Juncus* and *Drimys Winteri*, nearly all the plants show xerophytic adaptations; and the waxy coating of the leaves of *Drimys* may be considered as a xerophytic modification. Many of the plants complete their growth during one or two months of early spring, while the ground is moist, and then spend the summer in a resting condition, storing in a bulb or other underground stem the food that enables them to make a vigorous start the following spring. *Diposis Bulbocastanum*, *Cardamine alsophila*, *Oxalis articulata*, *Tropaeolum tricolor*, *T. brachyceras*, *Pasithea coerulea*, and many others belong to this group.

A smaller number of plants develop their leaves early, and flower in the summer after the leaves have disappeared. Among these are several species of *Alstroemeria*.

Many reduce the leaf-surface; some, as the cacti and *Ephedra*, have no functional leaves at any season; others have a well-developed leaf-system during the spring, but lose their leaves in summer. *Colletia ferox*, leafy during early spring, is at other seasons a mass of naked, thorny branches, the green epidermis taking the place of the leaves. *Talguenea costata*, *Schinus dependens*, *Proustia pungens*, and many others retain but a very few leaves during the summer. Others, as *Baccharis sagittalis*, *Mulinum spinosum*, *Acacia Cavenia*, species of *Calendrinia*, *Mutisia* and *Nassauvia*, have but a few small leaves throughout the growing period. Many, as *Aldunatea*, species of *Viola*, *Chuquiraga*, and *Nassauvia*, have small leaves closely crowded in rosettes or appressed closely to the stems. The crowding of the leaves in the mat formations of the mountains results in a reduced transpiring surface as well as protection from wind and snow.

Most of the trees are evergreen and have a waxy covering on the leaves. *Quillaja saponaria*, *Boldoa fragrans*, *Lithraea caustica*, *Kageneckia oblonga*, *Colliguaya* spp., *Escallonia arguta* and others have one or both sides of the leaves covered with a wax or varnish. A somewhat smaller number of plants have a resinous coating, among them several species of *Baccharis*, *Madia sativa*, *Cephalophora aromatica* and *Fabiana imbricata*. The last of these also has the leaves very small and closely appressed to the stems. Others, especially mountain plants, have the leaves densely covered with hairs; such are species of *Gnaphalium*, *Astragalus*, *Aldunatea* and *Patagonium*. During the middle of the day the leaflets of *Acacia Cavenia*, *Porlieria hygrometrica*, *Patagonium arboreum*, and a few other shrubs fold together, reducing the leaf-surface and placing the leaves edgewise to the sun's rays.

Nearly all the plants of the region have an extensive and usually deep root-system. The cacti, *Puya*, and certain orchids, as *Chloraea*, have fleshy stems that serve as water-reservoirs. *Alstroemeria*, *Oxalis*, and many others store water in the underground stems. Specimens of *Pasithea coerulea* had so much water in the stems and tubers and were so well protected by a waxy

covering that after being put in press fruits were matured from flowers that had just opened when they were put between the driers.

While several of the plants collected are not described in Gay's Historia de Chile, nearly all were found in the volumes so far pub-

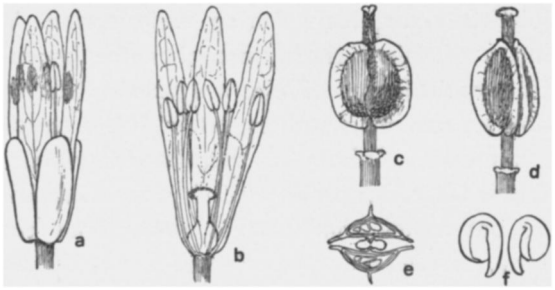

FIGURE 1. *Hexaptera purpurea* sp. nov. *a*, flower; *b*, flower, with one petal and two sepals removed; *c*, fruit, dorsal view; *d*, fruit, lateral view; *e*, fruit, transverse section; *f*, embryos.

lished of Reiche's Flora de Chile, that belonged to the orders therein described. Therefore, no attempt has been made to describe new species, with the exception of a *Hexaptera* (a small genus of the *Cruciferae* occurring only in Chile) found in the mountains near Laguna Negra.

Hexaptera purpurea sp. nov.

Perennial; stems 1–5, simple, smooth, green or purplish, 25–35 cm. high: leaves crowded at base of stem, narrowly spatulate, 5–7 cm. long, 2–5 mm. broad near the apex, tapering to the base, entire or with 1 or 2 sharp teeth near the apex, smooth, slightly fleshy; upper leaves few, smaller, 2–3 cm. long, 1–2 mm. broad: raceme terminal, simple or with 1–5 branches: flowers crowded: branches and stems elongating slightly after flowering so that the fruits are nearly separated except at the ends of the branches: peduncles 1–2 mm. long: sepals oblong, 4 mm. long, violet or black, erect: petals twice as long as the sepals, yellowish, violet on outer sides near tips: stamens free: fruit purple, the narrow wings white or slightly tinted.

Among rocks, near Laguna Negra, 3,500 m., province of Santiago, *Hastings 480*, February 6, 1902.

Distinguished from *H. linearis* Barn. by the numerous leaves

at the base of the stems, the leaves tapering to petioles, the branching, many-flowered racemes, and the violet-tinted petals.

Acknowledgment is due Prof. W. W. Rowlee for advice and assistance in determining the species collected, and to Cornell University for the use of a large amount of literature on the flora of Chile.

The species were named according to Reiche's "Flora de Chile," as far as published; otherwise the names are those given in Philippi's "Catalogus plantarum vascularium chilensium."

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